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**Notes:**

1. Untranslatable words are replaced with asterisks (\*\*\*\*).
2. Texts in the figures are not translated and shown as it is.

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**FULL CONTENTS**

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**[Claim(s)]**

[Claim 1] In the frozen equipment with which a compressor, a condensation machine, a pressure reducing device, and an evaporator are annularly connected by the refrigerant pipe, and it comes to form a frozen cycle The site glass possessing \*\*\*\* for checking by looking the state of the refrigerant which is prepared in said refrigerant pipe with which liquid cooling intermediation flows, and flows the inside of the pipe concerned, The light-emitting part which ejects light so that the refrigerant which is prepared in this site glass and flows the inside of the pipe of the refrigerant pipe concerned may be crossed, Frozen equipment characterized by establishing a judgment means to judge whether the amounts of refrigerants are insufficient based on at least two or more values among inclination of the light sensing portion which receives the light from this light-emitting part, and outputs a light-receiving signal, the strength of said light-receiving signal, change width, and change, and the number of times of vibration.

[Claim 2] Frozen equipment according to claim 1 characterized by preparing the light reflector which reflects the light ejected from the light-emitting part by said site glass, and receiving the light reflected by the light reflector concerned by said light sensing portion.

[Claim 3] Frozen equipment according to claim 1 or 2 characterized by establishing the control means equipped with the information equipment reported to light or sound when it is judged that the amounts of refrigerants run short by said judgment means.

[Claim 4] Frozen equipment given in Claims 1-3 any 1 clause characterized by establishing a stop means to stop judgment by said judgment means when it judges whether said frozen equipment reached steady operation and it is judged that steady operation is not reached.

[Claim 5] Frozen equipment given in the Claim 4 clause characterized by judging whether said frozen equipment reached steady operation by the lapsed time from the commencement of commercial operation of the frozen equipment concerned.

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] It is related with the frozen equipment which enabled it to judge whether it detects whether flash gas is intermingled to the refrigerant which flows the inside of a refrigerant pipe, and this invention is insufficient for it of the amount of refrigerants \*\*\*\*\*.

[0002]

[Description of the Prior Art] Generally, frozen equipment is formed with the compressor which compresses a refrigerant, the condensation machine which makes a refrigerant condense, the pressure reducing device from which a refrigerant is decompressed or extracted, the evaporator which evaporates a refrigerant, etc., these are annularly connected by the refrigerant pipe, and the refrigerant is enclosed with this refrigerant pipe.

[0003] If disclosure parts, such as a pinhole, exist in the connection place of a refrigerant pipe etc. for a certain Reason at this time, a refrigerant will be gradually revealed from there and it will be in the state where the amounts of refrigerants ran short.

[0004] After these amounts of refrigerants have run short, since frozen efficiency falls, a supplement of a refrigerant, repair of a disclosure part, etc. will be needed, and it will be necessary to investigate whether for this reason, the amounts of refrigerants are insufficient.

[0005] Although it is the most direct method to investigate pipe internal pressure power as a method of investigating the amount of refrigerants, the work of for that connecting a pressure gauge to a refrigerant pipe is needed, and while it is troublesome, a possibility that a refrigerant leak etc. may occur is during work.

[0006] Then, since the air bubbles called flash gas by liquid cooling intermediation will come to blend if the amounts of refrigerants run short, it is possible by detecting these air bubbles to judge whether the amounts of refrigerants run short.

[0007] From such a viewpoint, it sets, for example to JP,H7-43052,A, JP,H8-145518,A, etc. A light emitting element and a photo acceptance unit are prepared in the both sides of one pair of site glasses (two), respectively, and the frozen equipment which received the light from a light emitting element with the photo acceptance unit (photograph sensor) is indicated.

[0008] And it detects whether flash gas has generated the light from a photo acceptance unit from the light income change by flash gas carrying out dispersion etc., and it is judged whether based on this detection result, the amounts of refrigerants are insufficient.

[0009]

[Problem to be solved by the invention] However, in order to judge whether it detects whether flash gas has occurred only by light volume change which receives light by a light sensing portion with the above-mentioned composition, and the amounts of refrigerants are insufficient based on this, There was a problem incorrect-judged that the amounts of refrigerants run short

with the flash gas which occurs in the transitional state at the time of starting frozen equipment.

[0010] Moreover, even if it reached the stationary state, when garbage etc. was mixed in the refrigerant, there was a case where exact judgment became difficult.

[0011] That is, although it is ideal for a refrigerant that garbage etc. originally is not contained, garbage is generated from the sliding part of the motor which constitutes a compressor by prolonged operation etc., this garbage may adhere to a site glass, or light may be scattered.

[0012] In such a case, since the light income in a photo acceptance unit decreases, judgment whether to be insufficient, the existence of refrigerants, i.e., amount, of flash gas generating, will be misguided.

[0013] Moreover, also when garbage carried out passage etc. temporarily and dispersion was caused, there was a case where change of light volume arose and this was incorrect-detected with generating of flash gas.

[0014] Furthermore, when generating of flash gas was performed only by light volume change which receives light with a photo acceptance unit, it is difficult to acquire the details of a generating situation, and the alarm which tells the shortage of a refrigerant for this reason also had the problem which cannot but become uniform.

[0015] Then, this invention aims at offering the frozen equipment which could be made to do detailed information based on this while it enables it to detect the generating state of this flash gas in detail and with high precision.

[0016]

[Means for solving problem] [ invention concerning Claim 1 ] in order to solve the above-mentioned technical problem In the frozen equipment with which a compressor, a condensation machine, a pressure reducing device, and an evaporator are annularly connected by the refrigerant pipe, and it comes to form a frozen cycle The site glass possessing \*\*\*\* for checking by looking the state of the refrigerant which is prepared in the refrigerant pipe with which liquid cooling intermediation flows, and flows the inside of the pipe concerned, The light-emitting part which ejects light so that the refrigerant which is prepared in this site glass and flows the inside of the pipe of the refrigerant pipe concerned may be crossed, The light sensing portion which receives the light from this light-emitting part, and outputs a light-receiving signal, and the strength of a light-receiving signal, It is characterized by raising the judgment accuracy of whether as a judgment means to judge whether the amounts of refrigerants are insufficient based on at least two or more values among inclination of change width and change and the number of times of vibration is established and the generating state of flash gas can be detected in detail, the amounts of refrigerants are insufficient.

[0017] Invention concerning Claim 2 prepares the light reflector which reflects the light ejected

from the light-emitting part by the site glass, and the light reflected by the light reflector concerned is received by a light sensing portion. It is characterized by raising the judgment accuracy of whether as the generating state of flash gas can be detected in detail, the amounts of refrigerants are insufficient.

[0018] When it is judged that invention concerning Claim 3 runs short of the amounts of refrigerants by the judgment means, it is characterized by establishing the control means equipped with the information equipment reported to light or sound, and enabling it to report a detailed alarm.

[0019] Invention concerning Claim 4 is characterized by preventing the incorrect judgment in judgment whether a stop means to stop judgment by a judgment means is established, and the amounts of refrigerants are insufficient, when it judges whether frozen equipment reached steady operation and it is judged that steady operation is not reached.

[0020] Invention concerning Claim 6 is characterized by preventing the incorrect judgment in judgment whether \*\*\*\*\*, as it judges whether frozen equipment reached steady operation by the lapsed time from the commencement of commercial operation of the frozen equipment concerned, the amounts of refrigerants are insufficient.

[0021]

[Mode for carrying out the invention] The form of operation of this invention is explained with reference to a figure. In drawing 1, 1 is frozen equipment and this frozen equipment 1 is used for a refrigerator or an air harmony machine.

[0022] The condensation machine with which 2 was equipped with the compressor and 3 was equipped with the fan 50, and 4 A receiver tank, 5 and 11 a service valve and 6 a filter drier and 7 A MOISUCHA indicator (equivalent to a site glass), As for an evaporator and 12, an electromagnetic valve (opening-and-closing valve) and 9 are [ a nonreturn valve and 14 ] AKYU muletas an AKYU muleta with a built-in strainer, and 13 an expansion valve (pressure reducing device) and 10 8, it connects annularly with a refrigerant pipe and HC (high draw carbon) refrigerant etc. circulates through these.

[0023] 15 is the refrigerant pipe which connects the refrigerant pipe and compressor 2 of an outlet side of the receiver tank 4, and the strainer 16 and the capillary tube 17 are formed in this refrigerant pipe 15.

[0024] 19 is the refrigerant pipe which connects the entrance side of the AKYU muleta 12 the entrance side of the receiver tank 4, and the capillary tube 20, the height pressure pressure switch 21, and the capillary tube 22 are formed in this refrigerant pipe 19.

[0025] The MOISUCHA indicator 7 is shown in drawing 2 and drawing 3, and, as for glass \*\*\*\* and 7B, a light reflector and 7D of moisture \*\*\*\* and 7C are [ 7A ] sensors.

[0026] In addition, Sensor 7D is formed of the light-emitting part 7E which ejects infrared rays, and the light sensing portion 7F which receives infrared rays.

[0027] If flash gas (bubble) 23 exists during liquid cooling intermediation as shown in drawing 2, infrared rays will be scattered about with this flash gas 23, and the light income in a light sensing portion 7F will change.

[0028] It is a control device, the light-receiving signal from Sensor 7D and the signal from other sensors input 24 shown in drawing 4, and it controls a compressor 2, the expansion valve 9, information equipment 25, etc., and when frozen equipment 1 is [ and ] in a transitional state (control means), it stops state detection of a refrigerant (stop means).

[0029] Information equipment 25 is performed by any or 1 or more of the methods that a refrigerant leak is shown, for example with a display, light, a sign, etc. "with a refrigerant leak" with information sound, such as blink of a lamp, a buzzer, and alarm sound, and a display for indication.

[0030] Next, operation of this control device 24 is explained with reference to drawing 5. Operation of frozen equipment 1 judges first whether it is in a transitional state. This judges [ which set beforehand from commencement of commercial operation ] whether predetermined time progress was carried out (S1).

[0031] Thus, judging progress of predetermined time is based on the following Reasons. That is, in the transitional state after starting operation until it reaches steady operation, sufficient liquid cooling intermediation for a refrigerant pipe may not flow, but the liquid cooling intermediation having contained flash gas (bubble) may be flowing.

[0032] If the control device 24 operates in such the state and flash gas is detected, it will judge that a refrigerant is insufficient and will become malfunction. So, in the transitional state, it is made not to make a judgment with an insufficient refrigerant by the control device 24.

[0033] Since this transition duration changes with the size of frozen equipment 1, capacity, etc., he is trying to define transition duration beforehand by the set period of a timer in this invention. Thereby, even if it is the case where transition duration differs, it can respond easily.

[0034] Progress of predetermined time will judge next whether the rise of load is beyond a predetermined value (S2).

[0035] If the rise of load is beyond a predetermined value, will judge it as a transitional state, and the light-receiving signal from Sensor 7D will be kept from inputting, or the light-receiving signal from Sensor 7D will be disregarded.

[0036] Predetermined time passes since commencement of commercial operation, and if the rise of load is no longer beyond a predetermined value, the light-receiving signal from Sensor 7D will be inputted (S3).

[0037] If the refrigerant which circulates through the inside of the MOISUCHA indicator 7 is in the state of liquid, it will be reflected by a light reflector 7C, and the infrared rays from a light-emitting part 7E will be received by a light sensing portion 7F.

[0038] Since it is not in the state where the refrigerant has leaked if it is in this state, or since the quantity which has leaked even if the refrigerant has leaked is in few states, information is not performed.

[0039] If the leak of a refrigerant increases, flash gas will come to be mixed with the refrigerant which circulates through the inside of the MOISUCHA indicator 7, and the infrared rays from a light-emitting part 7E will come to be scattered about with flash gas.

[0040] Drawing 6 is the figure having shown the light-receiving signal from the situation in the refrigerant pipe in the case ( drawing 6 (a) ) where flash gas has not occurred, and the case ( drawing 6 (b) ) of having generated, and the light sensing portion 7F at that time.

[0041] As shown in this figure, when flash gas has not occurred, without carrying out dispersion etc., it is reflected by a light reflector 7C, and the infrared rays from a light-emitting part 7E are received by the light sensing portion 7F. Therefore, the light-receiving signal outputted from this light sensing portion 7F does not change in time.

[0042] However, if the light volume which will be received by the light sensing portion 7F if flash gas occurs changes, and a light-receiving signal also changes in connection with this, for example, the leak of a refrigerant becomes 10% or more of a predetermined fill ration, the light income of the infrared rays in a light sensing portion 7F will fall remarkably.

[0043] Then, generating of flash gas is judged from change of this light-receiving signal. As a judgment element, the signal strength I of a light-receiving signal, the change width D of a light-receiving signal, the inclination G of a light-receiving signal, the number of times N of vibration of a light-receiving signal, etc. can be listed.

[0044] Since the signal strength I will become small if flash gas occurs, if the signal strength I becomes small from the threshold  $V_{th}$  set up beforehand, it can be judged that flash gas occurred.

[0045] However, it produces, also when garbage etc. is mixed in a refrigerant, and the fall of such signal strength I becomes difficult [ it / to judge generating of flash gas correctly ] only with a threshold  $V_{th}$ .

[0046] However, when based on garbage, only when garbage passes, the signal strength I falls temporarily, or it vibrates depending on the density of garbage.

[0047] On the other hand, when flash gas has occurred by the shortage of a refrigerant, the signal strength I falls regularly and comes to vibrate with the pitch of abbreviation regularity.

[0048] Then, he is trying to judge whether based on at least two or more values, refrigerants are insufficient with a judgment means among the change width D of the signal strength I from a light sensing portion 7F, and signal strength, the inclination G of change of signal strength, and the number of times N of vibration of signal strength in this invention.

[0049] When change of the light-receiving signal by flash gas and garbage is generally compared, the garbage of the change width D of the signal strength I and the inclination G of

change is larger.

[0050] Moreover, in the case of garbage, change of the signal strength  $I$  comes to vibrate [ single shot ] regularly in many cases, without recovering, after carrying out signal change of the case of flash gas to this (when recovering for a short time).

[0051] Therefore, the signal strength  $I$  is smaller than a threshold  $V_{th}$ , and it becomes possible to judge what change of the signal strength  $I$  depends on garbage by whether the change width  $D$  or the inclination  $G$  of change has become beyond the predetermined value, or the thing to depend on flash gas.

[0052] Moreover, what change of signal strength depends on garbage by whether it reaches [ whether change is single shot-like and ] and the signal strength  $I$  after change is vibrating regularly, or the thing to depend on flash gas can be distinguished now.

[0053] And the information equipment 25 which is insufficient of the amounts of refrigerants and which the control device 24 will not illustrate if it judges is operated, and a refrigerant leak is reported to a user.

[0054] Since the generating situation of flash gas, i.e., the insufficient situation of the amount of refrigerants, can be judged from the size at this time, for example, the change width of signal strength Although refrigerants are insufficient, when satisfactory practically and you need maintenance check etc. while it is near, it can constitute so that it may divide and report, when you need maintenance check immediately.

[0055] If information equipment 25 works and is reported, a user telephones a serviceman and corresponds to a refrigerant leak.

[0056] Thus, with the frozen equipment 1 of this invention, since it judges automatically whether it is the leak of a refrigerant, and it reports, while being able to save the time and effort of a serviceman and the administrator of operation of frozen equipment 1 as much as possible, it can respond to the leak of a refrigerant promptly.

[0057] When inflammable HC refrigerant is used especially, there is a possibility that the escaped refrigerant may burn (it explodes when the amount of leaks is large), prompt correspondence is desirable, and according to this invention, it can respond promptly.

[0058] Moreover, according to this invention, it is also comparatively easy for the inner wall of the MOISUCHA indicator 7 to arrange a light reflector 7C. And since the sensor 7D equipped with the light-emitting part 7E and the light sensing portion 7F can also be installed from the outside of \*\*\*\*, the installation itself is comparatively easy and it can apply also to the already installed frozen equipment 1 comparatively easily.

[0059] Furthermore, since operation of frozen equipment 1 has judged whether it is between the predetermined time which defined beforehand whether it was in a transitional state from the commencement of commercial operation of frozen equipment 1 Although transitional time differs by the difference in the size of frozen equipment 1, and the fill ration of a refrigerant

(difference in refrigerant-pipe full length), it can respond comparatively easily only by setup of timer time, and it becomes possible to suppress a cost rise.

[0060] In addition, the above-mentioned transitional state points out the state of a to [ from a commencement-of-commercial-operation start / steady operation ], and the state where operation which load fluctuated rapidly and followed in footsteps of the load is carried out.

[0061]

[Effect of the Invention] The site glass possessing \*\*\*\* for checking by looking the state of the refrigerant which is prepared in the refrigerant pipe with which liquid cooling intermediation flows according to invention concerning Claim 1 as explained above, and flows the inside of the pipe concerned, The light-emitting part which ejects light so that the refrigerant which is prepared in this site glass and flows the inside of the pipe of the refrigerant pipe concerned may be crossed, Since a judgment means to judge whether the amounts of refrigerants are insufficient based on at least two or more values among inclination of the light sensing portion which receives the light from this light-emitting part, and outputs a light-receiving signal, the strength of a light-receiving signal, change width, and change, and the number of times of vibration was established The generating state of flash gas can be detected now in detail, and the judgment accuracy of whether the amounts of refrigerants are insufficient can be raised now.

[0062] Since the light which prepared the light reflector which reflects the light ejected from the light-emitting part by the site glass, and was reflected by the light reflector concerned was received by the light sensing portion according to invention concerning Claim 2 The judgment accuracy of whether the generating state of flash gas can be detected now in detail, and the amounts of refrigerants are insufficient can be raised now.

[0063] Since the control means equipped with the information equipment reported to light or sound was established when it was judged according to invention concerning Claim 3 that the amounts of refrigerants run short by the judgment means, a detailed alarm can be reported.

[0064] Since a stop means to stop judgment by a judgment means was established when according to invention concerning Claim 4 it judged whether frozen equipment reached steady operation and it was judged that steady operation is not reached, the incorrect judgment in judgment whether the amounts of refrigerants are insufficient can be prevented.

[0065] According to invention concerning Claim 6, the incorrect judgment in judgment whether \*\*\*\*\* , as it judges whether frozen equipment reached steady operation by the lapsed time from the commencement of commercial operation of the frozen equipment concerned, the amounts of refrigerants are insufficient can be prevented now.

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**[Brief Description of the Drawings]**

**[Drawing 1]** It is the circuit diagram of the frozen equipment applied to explanation of the form of operation of this invention.

**[Drawing 2]** It is the top view of the MOISUCHA indicator (site glass) of this frozen equipment.

**[Drawing 3]** It is the figure showing the relation between this MOISUCHA indicator (site glass) and a detector.

**[Drawing 4]** It is the block diagram showing each apparatus of frozen equipment.

**[Drawing 5]** It is the flow chart which shows the control action of this frozen equipment.

**[Drawing 6]** It is a figure explaining the state of the liquid cooling intermediation which flows the inside of a refrigerant pipe.

**[Explanations of letters or numerals]**

1 Frozen Equipment

2 Compressor

3 Condensation Machine

7 MOISUCHA Indicator (Site Glass)

7A \*\*\*\*

7C Light reflector

7E Light-emitting part

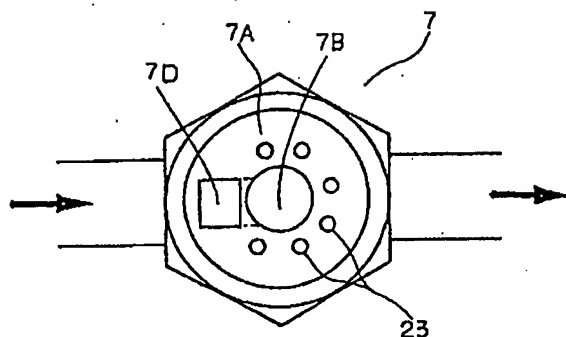
7F Light sensing portion

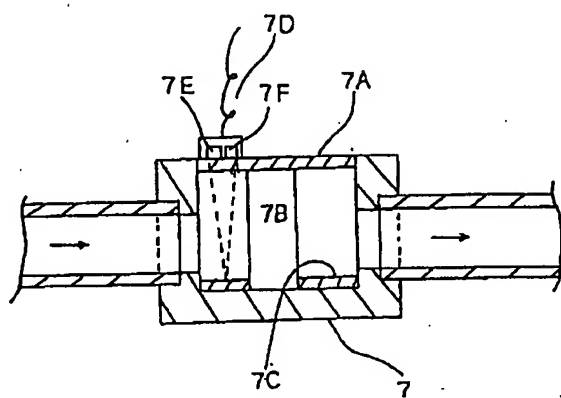
9 Pressure Reducing Device

10 Evaporator

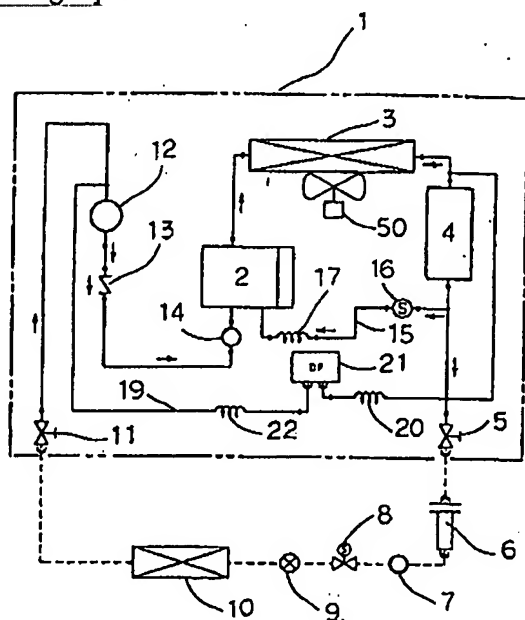
24 Control Device (Control Means, Stop Means)

25 Information Equipment

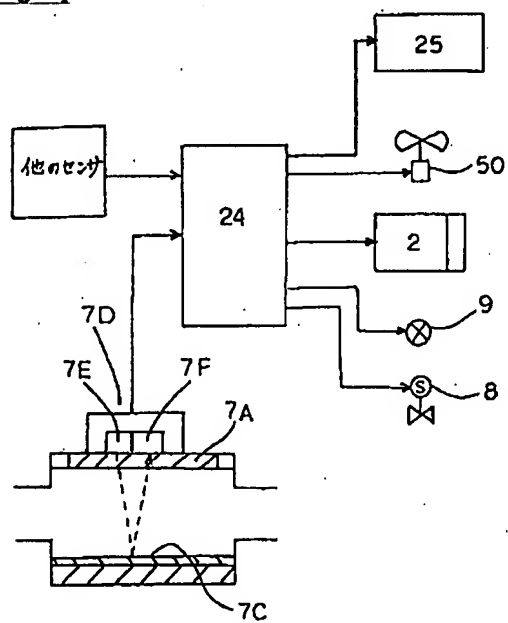
**[Drawing 2]****[Drawing 3]**



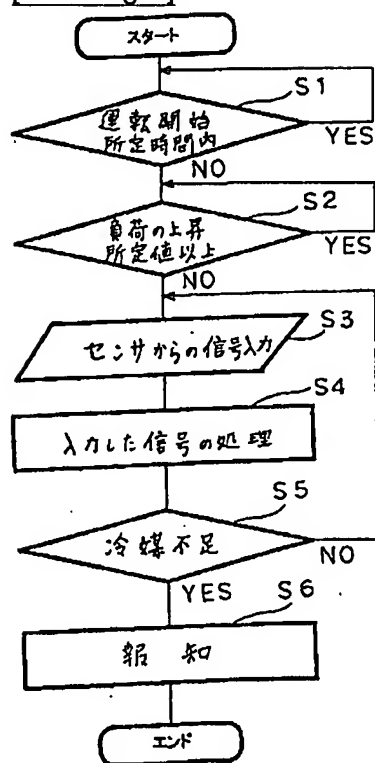
[Drawing 1]



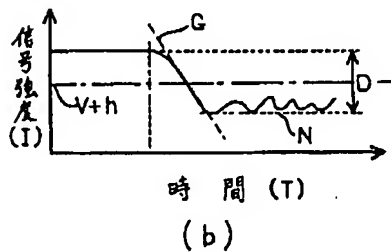
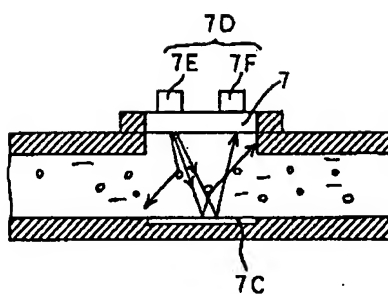
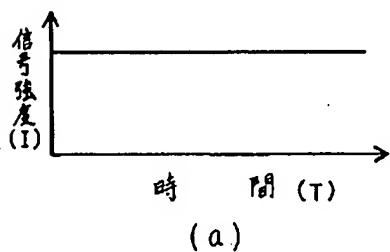
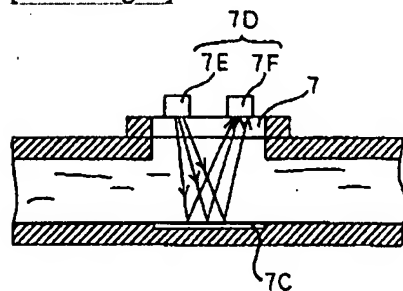
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Translation done.]